Using Freight Advanced Traveler Information Systems to Promote Urban Freight Mobility

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FRATIS Program Manager
Freight-Specific ITS Applications are Needed

- Technology is not used consistently by the trucking industry
- Trucks have unique operational characteristics
- Freight terminals do not always share queue information
- Existing public resources do not always provide freight-specific information
- System effectiveness is often limited by data availability and accuracy
The lack of Freight Advanced Traveler Information has negative effect on:

- Efficient Movement of Freight Transportation
- Planning of freight daily work activities
- Logistics Management Systems
- Environment of Neighboring Communities
- Energy Consumption
- Safety of the Traveling Public
Los Angeles/Long Beach Port User Survey Responses

Truck Drivers get their traveler information from a variety of traditional and technology based sources:

- CB Radio: 48%
- AM/FM Radio: 45%
- Dynamic Message Signs: 23%
- Smartphone App: 23%
- In-Dash Vehicle GPS: 22%
Los Angeles/Long Beach Port User Survey Responses

Truck Drivers use traveler information to make key decisions:

- Change Route En Route Based on Traveler Information: 47%
- Change Route Before Departure Based on Traveler Information: 42%
- Accept/Decline Assignments Based on Traveler Information: 11%
- Change PickUp/Delivery Times Based on Traveler Information: 11%

Source: Gateway Cities COG
**Los Angeles/Long Beach Port User Survey Responses**

Dispatchers in the region rated the value of the following improvements to traveler information:

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue Lengths at Port</td>
<td>4.0</td>
</tr>
<tr>
<td>Fastest Real-Time Routes</td>
<td>3.8</td>
</tr>
<tr>
<td>Bottleneck Locations</td>
<td>3.7</td>
</tr>
<tr>
<td>More Cameras in Port Area</td>
<td>3.7</td>
</tr>
<tr>
<td>Travel Times (Freeways)</td>
<td>3.7</td>
</tr>
<tr>
<td>Travel Time to Major Pickups</td>
<td>3.6</td>
</tr>
<tr>
<td>More Cameras on Freeway</td>
<td>3.4</td>
</tr>
<tr>
<td>Travel Times (Surface Streets)</td>
<td>3.1</td>
</tr>
<tr>
<td>More Cameras on Surface Streets</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Source: Gateway Cities COG
Freight Advanced Traveler Information System (FRATIS): Concepts and Potential Impacts

- **FRATIS Application: Freight-Specific Dynamic Travel Planning and Performance**
  - Enhances traveler information systems to address specific freight needs
  - Integrates data on wait times at intermodal facilities (e.g. ports), incident alerts, road closures, work zones, routing restrictions (hazmat, oversize/overweight)

- **FRATIS Application: Drayage Optimization**
  - Optimize truck/load movements between freight facilities, balancing early and late arrivals
  - Individual trucks are assigned time windows for pick-up or drop-off

- **10-year transformative impact targets**
  - Reduce truck travel times, 17%
  - Reduce bobtail (empty) trips, 15%
  - Reduce terminal wait times, 35%
  - Reduce freight-involved incidents, 35%
  - Reduce fuel consumption/emissions, 10%

FRATIS USDOT Lead: Randy Butler (FHWA Office of Operations)
FRATIS High-Level System Concept Focuses on Data Integration and Dissemination

Regional ITS Data

**Sources**
- Regional 511 Systems
- MPO
- State DOT
- Cities

**Types**
- Real-Time Freeway Speeds and Volumes
- Real-Time Key Arterial Speeds and Volumes
- Incident Information
- Road Closure Information
- Route Restrictions/Bridge Heights

Third Party Truck-Specific Movement Data

- Real-Time Speed Data from Fleet Management Systems GPS Data
- Cell Phone and/or Bluetooth Movement/Speed Data
- Truck Parking Availability

Intermodal Terminals Data

- Queue Length (Including Video)
- Container Availability Status

Regional Public-Private Partnership

Data Integration

Public Sector

Private Sector

Future U.S. DOT Connected Vehicle Data

- Road Weather Management – Route Specific Conditions and Forecasts
- “Probe Data” From V-V and V-I Connected Vehicle Technologies
- V-IV & V-I Safety Applications Data

FRATIS IT Toolkit

- ConOps, Architecture, Use Cases
- FRATIS Baseline API’s
- FRATIS Baseline Web and AED Apps
- FRATIS Testing Best Practices Guide and Performance Criteria
- FRATIS Business Plan

FRATIS Basic Applications

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - Based on Open Source Data and Services

FRATIS Commercial Applications

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - Value Added Services with Target Markets (For Profit)

API’s and/or Web Services

USDOT Open Source Web Portal
Benefits to Trucking Companies and Drivers

- Improve productivity and efficiency of the fleet
- Empower dispatchers with real-time information for faster and better decisions
- Generate near optimal trucks itinerary taking into consideration travel times with traffic, waiting times at the terminal, weather conditions, driver availability, etc.
- Dispatcher will have access to real time Terminal Waiting Times and Turn-Times
- Drivers will be able to navigate to their destinations and be rerouted in case of heavy traffic, incidents and congestion in their current route
What is the potential of a FRATIS System?

Summary Kansas City C-TIP Results

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Bob Tail Moves Eliminated</td>
<td>13%</td>
</tr>
<tr>
<td>Reduction in Fuel</td>
<td>8%</td>
</tr>
<tr>
<td>Reduction in Emissions</td>
<td>10%</td>
</tr>
<tr>
<td>Improvement in Travel Time</td>
<td>19%</td>
</tr>
</tbody>
</table>
Memphis Drayage Optimization Algorithm

Pre-deployment vs. Post-deployment pairwise comparison of average performance measures using clustered data sets:

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Pre vs. Post using clustered data sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobtail Miles Reduction</td>
<td>13%</td>
</tr>
<tr>
<td>Total Miles Reduction</td>
<td>9%</td>
</tr>
<tr>
<td>Average Miles per Truck Increase</td>
<td>14%</td>
</tr>
<tr>
<td>Required Fleet Size Reduction</td>
<td>21%</td>
</tr>
</tbody>
</table>
Benefits to Intermodal Facilities

- Receive pre-notifications containing details for trucks coming to perform transactions in their facilities
- Receive real time notifications of trucks heading towards their facilities with estimated time of arrival
- Reduce waiting time and turn around time at the facility
- Reduce unproductive pickups/drop-offs by enabling better container turns and reuse.
- Communicate directly with dispatcher to notify about terminal closures, incidents, or any other operational status in order to mitigate congestion in their facilities.
Public Benefits

- Promote better transportation planning and policy
- Improve air quality by reducing CO2 emissions
- Provides a platform to support economic development in the region
- Improve quality of life of the region
- Better utilization of existing infrastructure and capacity
- Provides capabilities for safer routes for trucking operations.
Three Initial FRATIS Prototypes Under Development

- **Los Angeles-Gateway Region:**
  - Develop FRATIS applications to address dynamic travel planning around the marine terminals and queues to move cargo out of the ports more efficiently

- **Dallas-Fort Worth, Texas:**
  - Incorporate integrated corridor management capability along with size and weight permitting
  - Test Connected Vehicle Basic Safety Message (SAE Standards J2735-2009)
  - Optimize drayage opportunities in coordination with rail and local truck drayage companies

- **South Florida:**
  - Similar focus as the other two sites, but includes emergency response capability to FRATIS that would integrate FRATIS functionality into Emergency Operations Center activity during an emergency such as a hurricane
FRATIS Modules

Planning Execution Monitoring
Planning

- Capture Operation Constraints
  - Truck routes
  - Distance between stops
  - Appointment time window at each stop
  - Travel time between stops
  - Traffic delays by time of day & day of the week
  - Weather condition and expected delays
  - Construction schedules on routes
  - Stop time for each job
  - Waiting time at each stop by time of day & day of the week
  - Drivers Hours of Service/Duty
  - Equipment related constraints
  - Special requirements (e.g. Hazmat)
Generate optimal plan

- The optimization algorithm recommends the best feasible plan that maximizes operational efficiency of freight pickups and deliveries of all the trucks in a given fleet, specifically the plan that will:
  - Maximizes value added moves
  - Minimizes non-value added moves
  - Maximizes load matching & backhauls
  - Minimizes travel time and traffic delays
  - Minimizes waiting time
  - Minimizes required fleet size
  - Maximizes the drivers productivity
  - Maximizes customer service level
Planning

- Communicate the plan details
  - Confirm jobs with drivers
  - Send jobs to drivers
  - Send notification to intermodal facilities/customers with plan specifics including the estimated time of arrival (ETA) to each stop location.
Execution

Drivers receive and execute Jobs

- Drivers receive the jobs including stop locations, sequence and timing on their smartphones or navigation device.
- The smartphone or navigation device will identify the best route between current driver location and the next stop location, the best route is determined based on:
  - Specific truck routes
  - Historical traffic information
  - Current traffic conditions
  - Construction schedules
  - Other constraints e.g. Hazmat Shipment, Over size, weather conditions, etc.
- Estimated time of arrival will be updated and communicated in real time.
- The smartphone or navigation device will identify alternate routes between stops in case of delays/incidents in the current route (dynamic routing).
Monitoring

Drivers’ availability (available drivers, maximum duty hours, maximum driving hours)

Estimated traffic conditions (travel times under traffic conditions)
FRATIS Project Status

- FRATIS Prototype
  - Architecture Complete
  - Baseline data for before and after complete
  - Development of the Application Complete
    - External Traffic Information
    - Devices Installed in 50 trucks
    - Optimization Algorithm designed for Marine Terminal Operations
    - Waiting times will be collected to measure queues at the gates

- Los Angeles FRATIS went live on December 11, 2013
- Dallas Live on for six month test being February 28, 2014
- South Florida planned to begin six month test on April 1, 2014
Preliminary Next Steps

Corridor Optimization for Freight (COfF)

Traveler Information During Construction (TIDC)
Actual Arrival Time: 5:50 PM
- Trip Delay 1 hr. 49 min. (40%)
- Missed the cut off time
- Delay in delivery to Customer
- Equipment related fines
- Lower driver productivity
- Lower efficiency
- Higher Carbon footprint

Traffic Incident
- Average Speed: 40 mph
- Unexpected Delay: 20 min.
- New Estimated Arrival Time: 5:51 PM

Traffic Congestion
- From 2:00 PM to 5:00 PM
- Average Speed: 30 mph
- Unexpected Delay: 35 min.
- New Estimated Arrival Time: 5:31 PM

Lane Closure
- From 12:00 AM to 3:00 PM
- Average Speed: 40 mph
- Unexpected Delay: 25 min.
- New Estimated Arrival Time: 4:56 PM

Road Construction
- From 10:00 AM to 5:00 PM
- Average Speed: 35 mph
- Unexpected Delay: 30 min.
- New Estimated Arrival Time: 4:31 PM

Trip Planning
Origin: UP-San Antonio Intermodal Terminal
Destination: BNSF-Alliance (Cutoff Time: 5:30 PM)
Distance: 298 Miles
Estimated Travel Time: 4 hrs. 31 min.
Departure: 11:30 AM
Estimated Arrival Time: 4:01 PM (Planned)

Current State
Limited or No Data
FRATIS Texas Project: Integration with I35TIDC

FRATIS will be integrated with the components of I-35 TIDC system to acquire high quality traffic and construction data in the optimization process.

- **Corridor Data Collection Subsystem “CDCS”** - historical data regarding average speed and average travel times on the different segments of the freight corridor.

- **Planned Closure Notification Subsystem “PCNS”** - XML data feed, information about all current and future lane closures.

- **Lane Closure Assessment Subsystem “LCAS”** - predict the impact on waiting queues and travel delays due to lane closures information attained from PCNS.

The integration of the three subsystems will create the complex traffic data body that will support the optimization engine with required information.

Determine the best dispatching time for trucks to adapt with the traffic flow on the I-35 freight corridor according to the dynamic changes of construction activities.
Scenario 2: USING DATA FROM I35TIDC MODULES TO PLAN FREIGHT PICKUP AND DELIVERY (NO OPTIMIZATION)
Trip Planning using I35TIDC
Origin: UP-San Antonio Intermodal Terminal
Destination: BNSF-Alliance (Cutoff Time: 5:30 PM)
Distance: 298 Miles
Estimated Travel Time: 6 hrs. 1 min.
Departure: 10:00 AM
Estimated Arrival Time: 4:01 PM (Planned)

- Actual Arrival Time: 4:21 PM
- Trip Delay: 1 hr. 49 min. (40%)
- Met the cut off time
- Delivery to Customer on time

Traffic Incident
Average Speed: 40 mph
Unexpected Delay: 20 min.
New Estimated Arrival Time: 4:21 PM

Traffic Congestion
From 2:00 PM to 5:00 PM
Average Speed: 30 mph
Expected Delay: 35 min.
New Estimated Arrival Time: 5:31 PM

Traffic Incident
Average Speed: 40 mph
Unexpected Delay: 20 min.
New Estimated Arrival Time: 4:21 PM

Accident Ahead

Traffic Congestion
From 2:00 PM to 5:00 PM
Average Speed: 30 mph
Expected Delay: 35 min.

Lane Closure
From 12:00 AM to 3:00 PM
Average Speed: 40 mph
Expected Delay: 25 min.
New Estimated Arrival Time: 4:56 PM

Road Construction
From 10:00 AM to 5:00 PM
Average Speed: 35 mph
Expected Delay: 30 min.
New Estimated Arrival Time: 3:58 PM

Trip Planning
Origin: UP-San Antonio Intermodal Terminal
Destination: BNSF-Alliance (Cutoff Time: 5:30 PM)
Distance: 298 Miles
Estimated Travel Time: 6 hrs. 1 min.
Departure: 10:00 AM
Estimated Arrival Time: 4:01 PM (Planned)
FRATIS Modules

Planning  Execution  Monitoring
Scenario 3: USING FRATIS OPTIMIZATION ENGINE CUSTOMIZED FOR I-35 CORRIDOR AND POWERED BY I35TIDC MODULES
Planning

- Utilizing Operation Constraints in the Corridor
  - Truck routes
  - Distance between stops
  - Appointment time window at each stop
  - Travel time between stops
  - Traffic delays by time of day & day of the week
  - Weather condition and expected delays
  - Construction schedules on routes
  - Stop time for each job
  - Waiting time at each stop by time of day & day of the week
  - Drivers Hours of Service/Duty
  - Equipment related constraints
  - Special requirements (e.g. Hazmat)
**Trip Planning**

*Origin: UP-San Antonio Intermodal Terminal*
*Destination: BNSF-Alliance (Cutoff Time: 5:30 PM)*
*Distance: 298 Miles*
*Estimated Travel Time: 4 hrs. 31 min.*
*Departure: 7:30 AM*
*Estimated Arrival Time: 12:01 PM (Planned)*

- **Actual Arrival Time:** 4:11 PM
- **Trip Delay:** 10 min. (4%)
- **Met the cut off time**
- **Delivery to Customer on time**

**Road Construction**

*From 10:00 AM to 5:00 PM*
*Average Speed: 35 mph*
*Expected Delay: 30 min.*
*New Estimated Arrival Time: 3:58 PM*

**Traffic Incident**

*Average Speed: 40 mph*
*Unexpected Delay: 10 min.*
*New Estimated Arrival Time: 4:11 PM*

**Traffic Congestion**

*From 2:00 PM to 5:00 PM*
*Average Speed: 30 mph*
*Expected Delay: 35 min.*
*New Estimated Arrival Time: 5:31 PM*

**Lane Closure**

*From 12:00 AM to 3:00 PM*
*Average Speed: 40 mph*
*Expected Delay: 25 min.*
*New Estimated Arrival Time: 4:56 PM*

**Traffic Incident**

*Average Speed: 40 mph*
*Unexpected Delay: 10 min.*
*New Estimated Arrival Time: 4:11 PM*

**Accident Ahead**

**Avoided Delay**

**Avoided Delay**

**Avoided Delay**

**Avoided Delay**
Before and After

<table>
<thead>
<tr>
<th>Planning Practice / Data Used</th>
<th>Current State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited or No Data</td>
<td></td>
</tr>
<tr>
<td>Departure time</td>
<td>11:30 AM</td>
</tr>
<tr>
<td>Estimated Trip Time</td>
<td>4 hrs. 31 min.</td>
</tr>
<tr>
<td>Actual Trip Time</td>
<td>6 hrs. 20 min.</td>
</tr>
<tr>
<td>Total Delay</td>
<td>1 hr. 49 min.</td>
</tr>
<tr>
<td>Cut-off Time</td>
<td>X Missed</td>
</tr>
<tr>
<td>Customer Service Level</td>
<td>Low</td>
</tr>
<tr>
<td>Productivity and Efficiency</td>
<td>Low</td>
</tr>
<tr>
<td>Impact on Congestion</td>
<td>Varies</td>
</tr>
<tr>
<td>Carbon Foot Print</td>
<td>High</td>
</tr>
</tbody>
</table>

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Questions?

For More Information …

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